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MICROPROCESSORS

Innovation Beyond Moore's Law

Innovation is the lifeblood of technology And successful innovation—that which is both **relevant and accessible—** rarely flows in a straight line. It is a bit surprising, then, that for much of the microprocessor era thus far its future has been as predictable as the X/Y axis of Moore's Law. Gordon Moore's prediction that every 18 to 24 months the number of transistors on a chip would double played out in an equivalent gain in single-threaded, system-level performance.

These performance gains came at a price, however. And when our industry hit a power wall a few years ago, we responded with multicore implementations. If we're not careful, this will lead to a **mindless "mutticore war"** where consumers are falsely led to believe more cores are always better, much as we endured a silly clock-rate war a decade ago. Is this really what the world needs from our industry?

Eighty-two percent ofthe world's population has yet to access the Internet. In 2005, U.S. data centers consumed as **much electricity as the entire state of Mississippi** did that same year. And as the differences between the TV PC, and cell phone blur, the integration of these devices—not just their raw performance—is increasingly important. These are the challenges facing our industry. And if we're going to address them successfully, we need to innovate far beyond the graph of Moore's Law.

Recently, we have begun to see new paths of innovation in the microprocessor industry beyond the confines of Moore's Law. Seamless integration between 32-bit and 64-bit processing made **the power of 64-bit computing** dramatically more attainable, and quickly established the mainstream x86, 64-bit computing market. The One Laptop Per Child initiative has innovated an entirely new business model to **bring the Internet to children all over the world.**

As energy efficiency continues to be a concern, we need to think differently about how to deliver the performance users need, We'll soon see a **coupling of the CPU and GPU** that will exponentially increase computing efficiency. And low-power cores will bring the x86 instruction set into devices where non-x86 chips are currently used—devices like HDTVs, hanciheld s, and personal video recorders, We'll even optimize monolithic silicon systems for specific usage scenarios, from data centers to video-enabled mobile devices.

These innovations are possible because **inspired engineers** are challenging themselves to find ways to make not more powerful processors, but more accessible and relevant computing. It is a challenge that will take them to unexpected places.

We'll continue to reap the benefit of **exponential transIstor density** increases for at least another decade. But this alone cannot be our value to customers. It's time our industry realizes that our future should be defined not by a technology prediction but instead by how well we address real customer needs. In other words, it is time for the microprocessor industry to join the rest of IT and become, well, a little less predictable.

revolutionary as was the transition from words and books to movies and video/ digital images.

Eventually, every moment of your entire life will be recorded in high- definition, 360-degree video and audio, and, naturally, your history will be stored in a randomly accessible **microchip that was subcutaneously implanted** in your neck when you were born. You've forgotten where you put the car keys? Just rewind your life until they appear. And because I'm an eternal optimist, I think **unbreakable encryption** will be developed that will ensure your life remains only yours—except, of course, if you're under 18. In that case, your parents will share the key.

NETWORKING

The Grid Takes Over

By Oliver Rist

Let's start with throughput. As 10-gigabit- per-second Ethernet over copper becomes cheaper over the next ten years, it will supplant Gigabit Ethernet as the most popular network medium. Lab curiosities at present,

4OGbE and 100GbE will become the new standards for high-end networks. TCP/IP will evolve as well, with the world

moving to IPv6 in five years because IPv4 is running out of address space.
You might think that wireless networking will supplant wired networks within this time frame, but you'd be wrong. That's because convergence is happening too quickly—using PCs as hubs for streaming video, voice, and increasingly complex online games. Wireless networks simply can't keep up with **good old copper** when your home network is running more than one of these applications. And wireless networks can't manage traffic flow as easily as wired can, which is critical for **smooth video streaming.**
Increased throughput and improved protocols are enablers, but they're the least exciting aspect of networking's